Technical note

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Effect of torsion angle on tension-torsion multiaxial fretting fatigue behaviors of steel wires

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Abstract: A tension-torsion multiaxial fretting fatigue test apparatus was employed to investigate the effect of torsion angle on multiaxial fretting fatigue behaviors of steel wires in the present study. Working principals and structures of the test apparatus were introduced. Evolutions with fatigue loading of hysteresis loops of tangential force versus relative displacement between contacting wires, and torque versus torsion angle of steel wire were explored. Three-dimensional white light interferometer was used to measure the deflection angle and size of wear scar. Coefficients of friction during tests at distinct torsion angles were compared. Crack propagation characteristics of steel wires were explored employing the X-ray computed tomography. The results show that both types of hysteresis loops present overall increased loop areas with increasing torsion angle. An increase of torsion angle induces increased deflection angle and size of wear scar, coefficient of friction and maximum crack depth of steel wire, which reveals accelerated multiaxial fretting fatigue damage.

Keywords: Steel wire; tension-torsion multiaxial fretting fatigue; torsion angle

1 Introduction

53% of proven coal resources in China are buried below kilometers [1]. Hoisting rope, as the key transmission component of multi-rope friction hoist system of the vertical shaft, connects the underground production system and the ground industry square. During lifting in kilometer deep coal mines, hoisting rope is subjected to dynamic stretching, bending and torsional loads [1]. Fracture failure of the hoisting rope causes the cage crashing accidents, and greatly affects the safe production and safety of miners [2]. Structurally, hoisting rope is twisted tightly between strands and